vated the season before. There was a good crop of prunes and plums, but no apples, and only a few pears.

The past season has been equally full of surprises and apparent contradictions. The killing frost this spring followed a dry storm. The temperature fell rapidly during the night of April 11, 1911, and at 6 a. m. April 12 stood at 30°. From 7 a. m. until 9.30 a. m. the thermometer stood at 28°, and it was not until nearly noon that it went above freezing. The lowest temperature reached during the night of the 12th was 21°, at 6 a. m. the following morning. Another cold night followed a day of high, cold winds. The temperature on the night of the 13th went as low as 22° and on the night of the 14th to about 28°.

One apricot orchard was heated during both of the colder nights, the average raise in temperature being about 4°. The irrigation stream was allowed to run on the other orchard both nights, and there is but little difference in the amount of fruit saved. It is difficult to tell just how much fruit there will be, but certainly not more than 5 per cent of a crop. Many of the branches are entirely devoid of fruit.

It had been planned to heat the peach orchards, but so much of the fruit was destroyed during the low temperatures and high winds of the forenoon of the 12th that the attempt was abandoned. The peaches were mostly in full bloom, though Triumph and White Clings were just beginning to blossom. In orchards Nos. 6 and 8 practically everything is gone except some of the White Clings. In orchard No. 4, which was a failure last year, there is a fair crop on most of the trees. The Crawfords, both early and late, seem to have suffered the most. There seems to be a fair scattering of Elbertas and a good crop of White Clings, Triumphs, and Sneeds. The conditions in those three orchards seem to have been completely reversed from last year, though during the past season cultural conditions have been the same.

The most curious thing about this freeze is that the prunes and apples, which are not yet showing color, were nearly all killed, while some of the peaches in full bloom were spared. Every season heretofore the prunes and apples have stood the low temperatures in the same orchards much better.

There is a great variation, then, in the amount of cold a bud or blossom can stand, but there is also great variation in the individual buds in their power to withstand cold. Thus a freeze that will kill one bud on a twig will leave unharmed the next three and then perhaps kill another, all apparently in the same stage of advancement. One bud may be spared in a cluster of apples or pears or cherries and all the rest taken. So it is sometimes with trees. One tree may bear a full crop and one in another row be fruitless. In many orchards on Provo Bench an orchard on one side of the highway will have a good crop of fruit, while one on the other side of the road will not have one live bud in several hundred. This seems to be true in orchards heated and not heated, pruned and unpruned, in sod or cultivated. Several unheated orchards will have more fruit than some that were heated.

There is much work to be done in determining the resistance of the fruit bud to frost and the factors that bring about such remarkable differences.

MEASURING THE SNOW LAYER IN MAPLE CREEK CANYON.

ALFRED H. THIESSEN, District Editor, and J. CECIL ALTER, Observer.

A vital question in all countries where irrigation is carried on is: How much water will there be for the coming growing season? At present irrigators are content with general estimates, as average, low, or large supply. The time will certainly come, however, when these general answers will not suffice, and the users of water must have more definite and even quantitative answers. The irrigation farmer, who formerly had plenty, and in fact did not know how much water he used, and actually wasted it, must now allow the water used by him to be measured, and can take only a certain portion, which is assumed sufficient for his needs. The broadening of our ideas has taught us that the newcomer has a certain right to some of the water, which the original user must respect. The old settler can not now use water prodigally, thereby depriving his new neighbor of his right to some of nature's gift.

One way by which can be calculated the water supply is to measure the repeated falls of snow in the mountains where the snow and ice are conserved for the spring and summer supply. It is quite impracticable to do this, however, due to the facts that few persons live in the mountains in winter, that repeated journeys thereto are costly, and that apparatus for automatically measuring falling snow is not perfected to a degree sufficient to make the measurements reliable. Granting that falling snow can be measured, then one can know the winter's precipitation, but not the available water supply, because during the winter thaws may occur, causing melting, the amount of which can not be easily measured.

It would seem, then, that the best way to determine the amount of snow that is to furnish water for irrigation is to measure the snow layer just before general melting begins. Measuring the depth and density of the snow layer in the spring was first done as early as 1905 in connection with river work. In 1910, Mr. J. Cecil Alter suggested that this method be applied to the measurement of the snow layer in the mountains of the West for determining the water supply for irrigation.

The ideal method of measuring the snow layer over a watershed would be to make gaugings of the snow depth and find the water equivalent at as many points as practicable within the area, at some uniform time near the end of the period of probable snow fall, determining as near as possible the proportional part that may be covered as compared with the total area of the watershed. A simple calculation will then give the amount of water in acre-feet in the watershed. Gauge readings at the outlet of the watershed will give at any time the amount of water that has passed at that point, subtracting which from the amount found in the watershed will give the amount still unmelted. There are, of course, certain factors such as evaporation, seepage, and rainfall subsequent to the time that the snow survey was made which should be known. But it is thought that these may be measured or estimated so that the results of the snow survey would be very valuable.

If the farmers depending upon irrigation know that they will for a certainty have much more water than usual, they may plant crops which require considerable water, or the irrigation company may sell the surplus water to adjacent farmers, who with the water may increase the value of their crops. On the other hand, if it is found that the water supply is below normal, crops requiring less water may be planted. In either case the result would tend toward increased profit for the farmer, and hence the county, State, and country would be that much the richer.

During the past March a snow survey was made of Maple Creek Canyon, Utah, according to the plan outlined above. This canyon is the first one north of Spanish Fork Canyon, through which the Rio Grande Railroad finds a passage over the Wasatch Mountains. It is a broad canyon with few precipices, and relatively smooth, and was chosen for the experiment because it presented fewer natural obstacles to such a survey than any other canyon sufficiently near Salt Lake City to be readily accessible.

The instruments used consisted of a density tube and scale, an aneroid barometer, a compass, and a metal semicircle with plumb and pointer to secure slope angles. Besides the ordinary clothing, snowshoes and an alpenstock were indispensable.

The distance from the outlet of Maple Creek east and southeast to the head of the longest fork was measured with a 250-foot line, and by a complete system of field notes and diagrams all the important landmarks were located, including the turns in the canyon and all branches. The direction angles from turn to turn were obtained with a compass. From this general information a map was sketched showing the main canyon and the outlets of all the branches. The longest lateral is the first one from the outlet leading southward; at the southern extremity, or head of this canyon, is a high peak visible far out into the valley to the westward, and by extending sight lines from the fence and road lines in the valley the location of the south side of the watershed was determined.

The work thereafter consisted in going up the bottom of each gulch or canyon and back and forth along the slopes, measuring the snow depth and density every thousand feet or so, and platting the gulch or canyon on the preliminary sketch map more accurately, and mapping the snow areas in the canyons. The contours of elevation were pretty accurately determined by frequent aneroid barometer readings.

The object in making each snow measurement was to get values that were typical or representative for regions several acres in extent, which will be comparable from year to year, also which could be located in a year or so hence from field notes made on this trip. The measurement consisted of numerous soundings of the snow layer with a graduated alpenstock in apparently average places, after which the section of snow, estimated as the average, was removed with the tube and weighed by slinging the spring balance scales from the alpenstock thrust into the snow at an angle.

Having all section lines platted on the map, as well as the extent of the snow cover, the total acreage of the watershed was found to be about 6,880 acres, about 4,000 acres being under snow when measured the last decade in March, 1911. About 2,000 soundings were made with the graduated alpenstock and 277 measurements of the depth and density were made in carefully selected representative places with Prof. C. F. Marvin's density apparatus. This is an average of 1 density measurement to each 14 acres of snow. The average of the 277 depth measurements was 36 inches, and the average water equivalent was 11.5 inches, or 32 per cent, making 3,833 acre-feet of water, or enough to spread 14 inches deep over all the land irrigated under the stream, the farm acreage irrigated under Maple Creek having been previously platted. In all cases the actual depth of the snow layer, not the vertical depth of the snow, was measured, the tube being inserted perpendicular to the surface of the slopes.

Owing to an unusually large amount of rocks in the earth formation of this region there is a great loss of water by seepage. Whether this water appears or not out in the Utah Valley on or beyond Mapleton Bench is not definitely known, but it probably does not appear at such places as render it useful, as flowing wells are hard to obtain. However, a few springs appear along the foot of the mountains at the east edge of Utah Valley, and one or two farmers have developed sufficient irrigation water for their farms by tunneling into the foothills and creating springs. This process has apparently not affected the flow elsewhere. There are springs also at a number of places in the watershed, most of them breaking out of the north slopes of the mountains toward the main canyon. These springs are said to flow throughout the year at about the same rate.

The loss of water is very conspicuous, in many places a good sized stream disappearing within the space of a few yards. Two or 3 miles of the main stream have been diverted from the natural leaky bed into a new ditch, which winds its way from the first large branch practically all the way to Maple Creek outlet. Even this stream varies in size through receipt and loss of water on the way. A dam is proposed just below the mouth of Right Hand Fork, across the main canyon, to be made of concrete, laid on the bedrock, and extending into the mountains on each side of the canyon, which it is expected will pick up much of the seepage loss occurring above this point. The Maple Creek water users, who are constructing the dam, have been assured by certain capitalists that if 8 or 10 second-feet of water is picked up by the dam it will be carried to the edge of Mapleton in a flume and there used for generating electric light and power, and then given back to the irrigators. When this work has been completed, if successful, the seepage loss will be a comparatively small factor.

Extracts and summaries from field notes made in all the hollows and branch canyons have been prepared in such a way as to be comparable from year to year. The following order of canyons is that in which they occur from the left of the watershed (the north) around through the head of the main canyon and back along the right or south side from the head to the mouth of the main canyon. The names of the canyons are those by which they are commonly known to residents of Mapleton.

MAPLE CREEK CANYON.

The main canyon was practically bare, no snow being observed on the north side, and only a few regions on the south side carried snow. Just west of the outlet of Left Hand Fork, which is really the extension of the main canyon, and just west of the outlet of Dibble Fork, scattering patches of snow appeared, but the depth and the extent were small.

PERRY HOLLOW.

There was none on the north side and only a trace on the south side below the turn; from the turn to the head on Grindstone Mountain the south side was well covered. The average depth determined from the means of 11 measurements, which were taken in carefully selected representative places, was 23.7 inches. The density apparatus showed this snow to contain on the average 7.7 inches of water, or 32 per cent. There were no drifts, and there were no regions of greater or less packing.

SQUAW HOLLOW.

Snow covered this hollow, except the western half of the north side. The average depth of seven well-selected measurements was 22.1 inches, with a water equivalent of 7.1 inches, or 32 per cent. There were no drifts and the snow was loose.

TUCKETT HOLLOW.

The western half of the north side was bare; the third one-fourth on the north side carried patches of snow; the rest of the hollow was well covered, the average of 27 measurements being 35.3 inches, with a water equivalent of 11.8 inches, or 33 per cent. There were no drifts and the snow was loose.

LEFT HAND FORK.

(Main canyon beyond turn.)

The canyon was bare on the east side, from the outlet to Tuckett Hollow; elsewhere it was well covered, but while there was no drifting to speak of the slope on the south is so uneven and presents so many different exposures to wind and temperature that a wide variety of depths was recorded. However, fairly good average regions were obtained in practically every case. The mean depth determined from 48 measurements was 35.2 inches, having an average water equivalent of only 8.4 inches, or 24 per cent. The dryness of the snow was probably due to the steepness of the slope permitting free drainage and to the northeast exposure, which receives little sunshine.

MAPLE HOLLOW.

All of this hollow was quite uniformly covered with snow, but there were no drifts and the snow was loose. The mean of 14 average places was 38.2 inches, with an average water equivalent of 12.1 inches, or 32 per cent.

DIAMOND HOLLOW.

This branch was completely covered with loose snow, there being no drifts. The average of 14 measurements for depth was 40.1 inches, and the average water equivalent was 13.9 inches, or 35 per cent.

LEFT HAND FORK OF DIBBLE.

The west half of the north side was practically bare, except in the bottom, and the east half of the north side carried only a small amount, the ground being bare under the heavier bushes and trees and over the bearberry bushes. Over the remainder of this gulley the snow was deposited quite evenly, and it lay where it had fallen, as there were no drifts. The average of 19 measurements in well-selected places was 41.9 inches, with a water content of 14.4 inches, or 34 per cent.

MAIN DIBBLE FORK.

This canyon was quite evenly covered with soft snow everywhere, except below the left-hand fork. From the Dibble Fork to the main Maple Canyon the amount was generally unmeasurable, being patchy near Dibble Fork and only a trace near the outlet. High up on the ridge to the west some drifting was noted, but the amount of snow in the drifts was small compared with that lying on the rest of the slopes. The average of 46 measurements in well-selected places in this canyon was 37.3 inches, with an average water equivalent of 13 inches, or 35 per cent.

VAN LUVEN HOLLOW.

This branch was bare near the outlet and for some distance south, and only a trace lay on the slopes as far as two-thirds of the way to the top. Above this, despite the great steepness of the slope, the snow was quite evenly distributed. The average of 9 measurements was 27.3 inches, having an average water equivalent of 8.3 inches, or 30 per cent.

RIGHT HAND FORK.

From the outlet to the first curve this canyon was bare. From the first curve to Bung Hole Hollow the snow was patchy, the ground being fairly well covered generally, except under the scattering trees and large shrubs, though much of the east side along here carried only a trace on the top two-thirds of the slope, extending as far south as the first high peak on the east ridge. From here to the head of the canyon the east slope is so steep that only a small amount of snow clung to the stony sides. The slope was so steep that exact measurements were impracticable, though it was noted that many rocks were exposed, showing an uneven, probably light deposit. At the base of this slope a considerable quantity of snow had slid and rolled from the higher slope and lay from 4 to more than 7 feet deep in a belt ranging from 100 to 300 feet wide and extending a distance of a mile or more northward from the head, with occasional breaks, due to the pine tree clusters. On the greater part of the west side and on the broad bottom of this canyon, typical, average measurements were quite practicable, and 44 were made. The mean depth was 40.5 inches, with a water equivalent of 13.8 inches, or 34 per cent.

SERVICE BERRY HOLLOW.

This gulley carried no snow except on the upper one-third, the average of 4 representative measurements being 19.2 inches, with a water equivalent of 5.9 inches, or 31 per cent.

MAPLE CANYON SLIDE.

This region is quite steep to the north, yet it carries a very even deposit of snow. The lower one-half on both sides of the ravine was bare, or carried but a trace in patches. Higher up among the scattering pines and quaking asp trees, and in the open spaces from the crests down to about the 7,000-foot elevation contour, the average of 34 representative measurements was 37 inches with a water equivalent of 11.4 inches, or 34 per cent.

If work as described above were carried on in any watershed for a period of at least three years, it is thought that ample data would be obtained to make predictions of water supply which would be very valuable.